Fermilab

$\bar{p}$ Note #381

Residual Activity Exposure Rates Downstream of the $\bar{p}$ Target Vault

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Operation of the $\bar{p}$ target station is likely to produce activation of material on the downstream end of the target vault from penetration of some portion of the beam and leakage along the $\bar{p}$ collection channel. The Monte Carlo particle tracking program MAXIM is used to estimate the extent of this activation and the resulting exposure levels personnel may encounter.

The physical geometry modeled for MAXIM is depicted in figure 1. Four regions of potential concern are specifically investigated. These are; 1) the downstream face of the steel shielding pile concentric with the incident beam axis and having a diameter of one foot 2) the area concentric to the collection channel of diameter one foot 3) the area symmetric to the collection channel with respect to the incident beam axis 4) the upstream face of the first quadrapole after the shielding steel in the collector channel.

Following Chapter 12 of the Radiation Guide[1] we calculate the dose rate from the formula $D = \frac{\Omega}{4\pi}.S.W$ where Ω is the solid angle subtended by the source as seen from the detector, S is the rate of star production per cm^3 and W is a material dependant proportionality factor that is a function of irradiation time and cooldown time. From Maxim run PMYOGCF we obtain the star densities for the regions we wish to investigate and with a targeting rate of 3×10^{12} P/2sec we determine S. The solid angle Ω subtend by a detector placed one foot away is approximately $\frac{2\pi}{3}$ steradians. The proportionality factor for iron from A. Van Ginneken[2] is $W(\infty, o) = 9 \times 10^{-6}$ $\frac{\text{Rad/hr}}{\text{star/cm}^3.\text{sec}}$ with infinite irradiation and no cooldown and $W(30d, 1d) = 2.5 \times 10^{-6}$ $\frac{\text{Rad/hr}}{\text{Star/cm}^3.\text{sec}}$ for 30 day irradiation and 1 day cooldown. Table 1 summarizes the results.

We find the dose rates may be moderately high and that work can be permitted with some restriction on access. As the target station ages the residual activity will increase however, these estimates are for a continuous targeting rate of 3×10^{12} p/sec which is not expected to occur indefinitely as in the infinite irradiation case. Hence, the $W(\infty, o)$ serves as an upper bound for the long term build up.

TABLE 1

Region	Star Density Stars/cm^3	Dose Rate W(30d,1d) mrem/hr	Dose Rate W(∞,o) mrem/hr.
1	1.63×10^{-7}	102	367
2	5.99×10^{-7}	374	1348
3	3.7×10^{-8}	23	83
4	2.47×10^{-7}	154	554

Reference

1) Radiation Guide 4th Edition April 83.

2) A. Van Ginneken and M. Awschalom, "High Energy Particle Interactions in Large Targets", Fermilab 1975.

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ENGINEERING NOTE

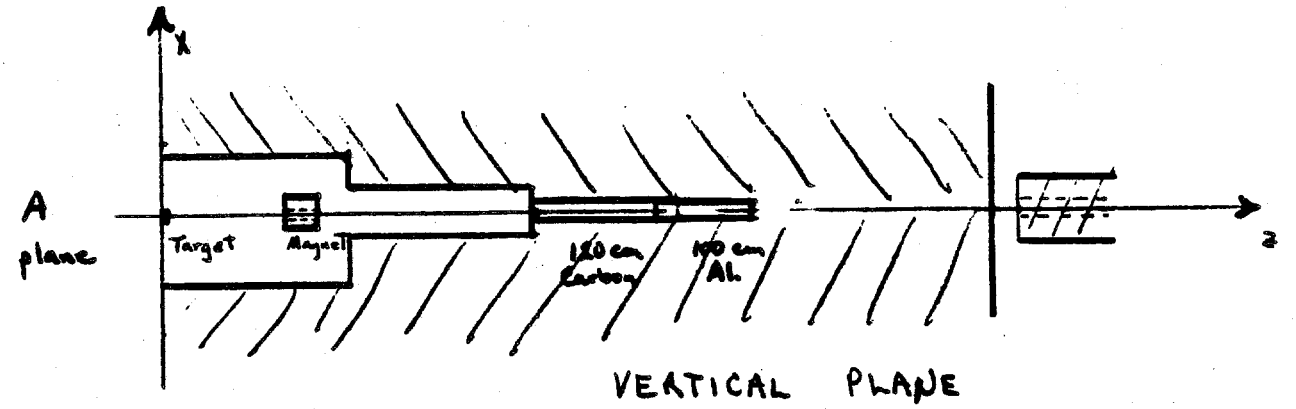
SECTION	PROJECT	SERIAL-CATEGORY	PAGE

SUBJECT: ACTIVATION DOWNSTREAM OF P VAULT

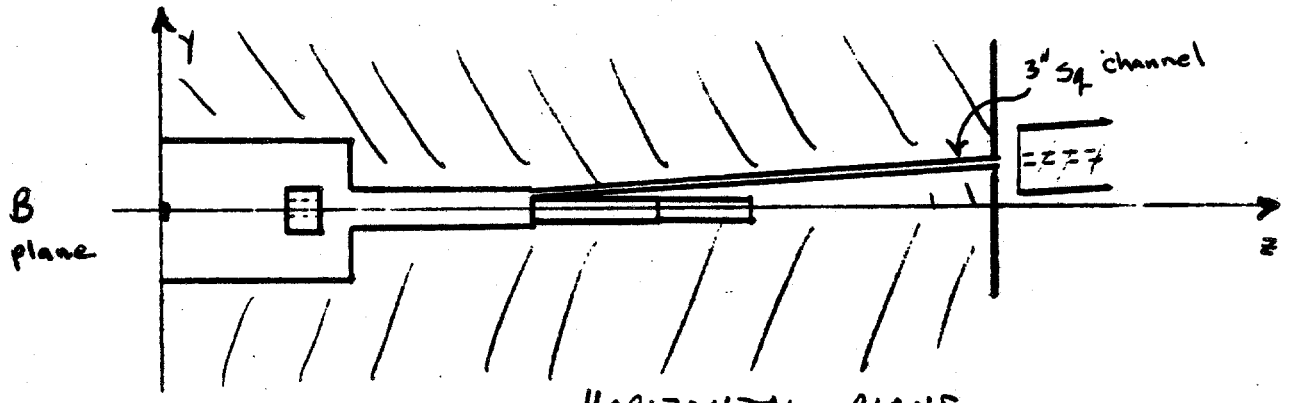
NAME: PMM

DATE: 4/2/84

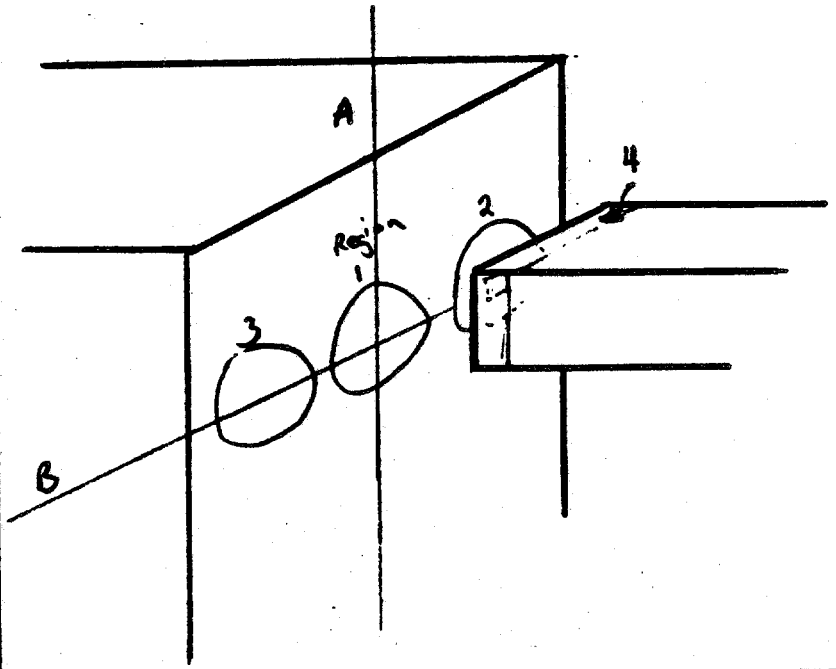
REVISION DATE:



VERTICAL PLANE



HORIZONTAL PLANE



Not to scale

FIG 1